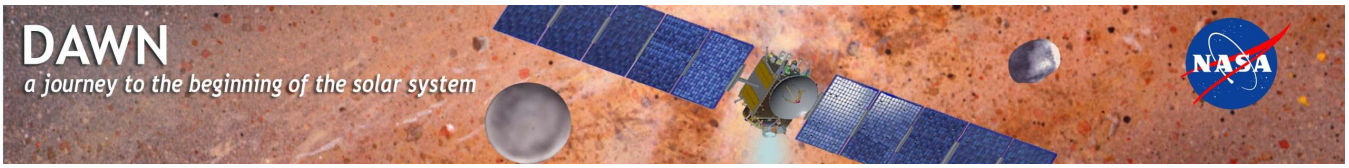


History and Discovery of Asteroids

Seeing Faraway Things as Though Nearby

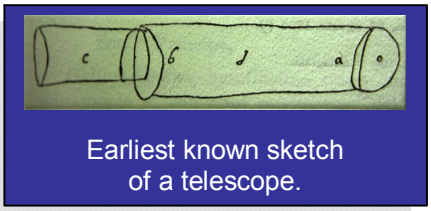
FLASHBACK— Astronomy with the First Telescopes

The work of early scientists like Copernicus[1], Brahe, and Kepler[2] was remarkable! All their observations were made by simply using their own eyes. The invention of the telescope, a technological breakthrough, allowed scientists to "extend their senses."

Who Invented the Telescope?

No one knows for sure who invented the telescope. It may have been two little children who were playing with lenses in the shop of **Hans Lippershey**, a Dutch reading-glasses maker. The story is told that when the children looked at a weather vane on a nearby church through two lenses held together, it became larger and clearer. The rest of the story is that Lippershey then put a tube in between the two lenses, thereby inventing one of the first telescopes. This early model only magnified an image by 3 or 4 times. This means that a marble seen through this device would appear 3 or 4 times larger than its actual size—maybe the size as a ping-pong ball.

Lippershey was the first person to try to sell his telescope. In 1608, he applied to the Belgian government for a **patent** on a device with multiple lenses. A patent would protect his idea from being stolen by another person. Lippershey was required to make three identical telescopes and to keep his method a secret. Making more devices was not a problem for him, but he had trouble keeping his secret. So, a short time later, **Jacob Metius** applied to the same government office for a patent on a device for "seeing faraway things as though nearby." His device was a tube with one lens that curved outward and one lens that curved inward.



Earliest known sketch of a telescope.

There are two different versions of what the government's patent board decided. One version is that they turned down Metius' application. Metius became so upset that he refused to show his telescope to anyone. It is said that even the tools he used to make it were destroyed after he died.

The other version of the story says that government officials discussed the patent applications of both Lippershey and Metius. They thought that the device was too easy to copy to patent, so they gave Metius a small amount of money and paid Lippershey "handsomely" to make several copies of his device.

These early devices looked more like our modern day "spyglasses" than our modern telescopes. Because they used lenses that **refracted** (or bent) light, they were called **refractor** telescopes.

Galileo Received Undo Credit for the Refractor Telescope

In July of 1609, **Galileo** heard that Lippershey was on his way to Venice to sell his invention "that made distant objects seem near." Galileo needed money, and the Venetians were offering Lippershey a high price for his device. In 24 hours, Galileo had a telescope made and sent word of "his invention" to a monk in a high office of the government. For this, Galileo received a raise in salary from 520 to 1000 florins per year.

Whatever the truth of these stories, three things are certain. One, the first telescopes were *not* invented by scientists, but by craftsman; two, Galileo did *not* invent the refractor the telescope; and finally, telescopes revolutionized astronomical observation. Scientists depended upon larger and better telescopes to advance their study of the universe.

Astronomers used the new telescope to make better observations.

The 40-inch refractor at the Yerkes Observatory set out to be the largest telescope in the world when construction began in 1890. Today, it still is the largest. A special dome and floor had to be custom built for the telescope.

Galileo used refractor telescopes with lenses that magnified objects about eight times their size. With these instruments, he discovered the satellites of Jupiter, the rings of Saturn, the changing shape of Venus, sunspots, and solar rotation in less than ten years. During the same decade, at least ten other astronomers built their own refractor telescopes using different combinations and types of lenses. Many of these were used to verify, support and extend Galileo's discoveries.

Isaac Newton built a Reflector Telescope

In 1668 Isaac Newton, an English mathematician, built a **reflector** telescope that used a metal mirror to gather and focus light rays. Objects like planets and asteroids are so far away that all of the light rays coming from them reach the Earth as parallel rays. In the reflector telescope, one or more curved reflector mirrors focus those parallel lights rays to a single point. All modern research telescopes and large amateur ones are of the reflector type. William Hershel, a musician turned observational astronomer, built a telescope that was used by **Johann Schröter**, the elected president of a society sometimes called the **Celestial Police**[3]. This group was formed for the expressed purpose of searching for and discovering the "missing planet" that Kepler[2] predicted would be found between the orbits of Mars and Jupiter.

[1] see "Thinking Outside the Box"
[2] see "Between Jupiter and Mars"
[3] The Activity, "In Search Of…," shows how the Celestial Police carried out their investigations.

Additional Resources

http://seds.lpl.arizona.edu/billa/psc/hist2.html
This section of *Important Astronomers, Their Instruments, and Discoveries*, focuses on the history of the early refracting telescopes.

http://www.astronomynotes.com/telescop/s2.htm
This site provides a design diagram as well as lists the advantages and disadvantages of refractor telescopes.

http://www.astronomynotes.com/telescop/s3.htm
This site provides a design diagram as well as lists the advantages and disadvantages of reflector telescopes.

http://www.detroitobservatory.umich.edu/Telescopes.html
The University of Michigan Detroit Observatory provides information and pictures of various telescopes throughout history.

http://hou.lbl.gov/~vhoette/Explorations/OpticalPowers/1-telescope-pictures.html
This site provides many pictures of the telescopes available at The University of Chicago Yerkes Observatory. Also a question activity is included to get learners to figure out the different parts required for different kinds of telescopes.

http://astro.uchicago.edu/vtour/defn.html
This Yerkes Observatory site offers helpful explanations of the differences between refractor and reflector telescopes.

http://astro.uchicago.edu/vtour/
Take a virtual tour of the 100-year old Yerkes Observatory at the University of Chicago. See and learn about the five research telescopes used at the observatory, including the largest refractor telescope.

http://es.rice.edu/ES/humsoc/Galileo/Things/telescope.html
Rice University provides information about the history of the telescope.

http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Galileo.html
More information about Galileo, his family, and his work.

Questions relating to Seeing Faraway Things as Though Nearby

1. Do we know exactly who invented the telescope? Why or why not?
2. Do we know when the telescope was invented?
3. What is the difference between refracting and reflecting telescopes?
4. What is the difference between convex and concave lenses?
5. What was the magnification power of the refractor telescopes used by Galileo? What was he able to see with this refractor telescope? Did he discover any asteroids?
6. What were the Celestial Police looking for? [The missing planet between Jupiter and Mars.]
   Using the Internet, find and print two diagrams: one should show how a refracting telescope works, and the other should illustrate how a reflecting telescope functions.